MINT FARMING

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THE culture of peppermint and spearmint in the United States and the distillation of oil from these plants is centralized in the muck lands of Indiana, Michigan, western Oregon, Washington, California, and Ohio. Conditions there are especially favorable to the crop, and in 1947 about 47,000 acres of peppermint and 14,000 acres of spearmint were under cultivation. The industry is capable of considerable expansion in these and other localities if greater commercial demands for the oils should develop.

An important feature of mint farming is the removal of the oil from the hay by steam distillation, for which special equipment must be provided. If properly handled, mint brings fair returns to those who grow it as an established farming operation. The crop is very susceptible to unfavorable weather, however, and the yield of oil per acre therefore varies greatly from year to year. The market demand for mint oils has increased steadily, but a sudden and considerable increase in production would no doubt have a most unfavorable effect on the industry.

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Contents

PEPPERMINT AND SPEARMINT yield essential oils, which are their principal marketable products, although there is a limited use for the fresh and dried herb as a condiment. Peppermint oil, the more important of the two, is used in numerous medicinal products, but chiefly for flavoring chewing gum, candy, and tooth paste. Spearmint oil is less in demand, because its use has been confined largely to flavoring chewing gum. Recently, however, several large manufacturers have been using spearmint oil for flavoring tooth paste.

MINT-PRODUCING AREAS

Commercial peppermint culture was introduced into the United States about 1812, at Ashfield, Mass., and by 1825 several hundred acres were under cultivation there. About 1816 the crop [2] became established in Wayne County, N. Y., and from there its culture extended westward, first to northern Ohio and later to southern Michigan, where in 1835 the first plantings were made in St. Joseph County. The success of this venture led to the extension of the industry into the southwestern part of the State and into the northern counties of Indiana. The large areas of muck soil were found to be so well adapted to mint culture that this region soon became the center

[1] Acknowledgment is made to members of the agricultural experiment stations of Purdue (Ind.) University, of the Michigan, Oregon, and Washington State Colleges, and of the University of California for their cooperation; in particular to N. Kent Ellis, of the Purdue station.

[2] The terms "crop" and "mint" are used in this bulletin to designate either peppermint or spearmint, or both, since the culture and harvesting practices for the two are essentially the same.

of production. Plantings in central New York have been gradually reduced until at present no commercial plantings are found there.

Success in mint culture on the muck lands of the Middle West naturally led to experimental plantings in other parts of the country having similar soils. About 1909 it was found that in parts of western Oregon and Washington the soil and climate were favorable. The mint crop was soon introduced along the Willamette River in Oregon and on both sides of the Columbia River and on the islands from Portland west. In recent years the crop has become firmly established in the irrigated districts in the Yakima Valley from Yakima east to the Kennewick area and also in the Sacramento delta district of San Joaquin County, Calif.[3] The principal mint-producing areas of the United States are shown in figure 1.

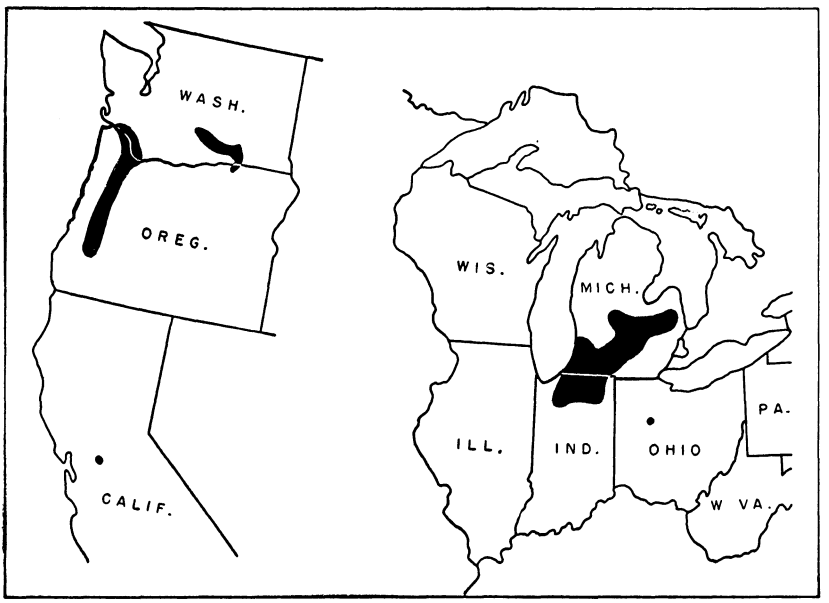


FIGURE 1.—The principal mint-producing areas of the United States in 1947.

Spearmint is grown commercially only in the Michigan-Indiana district, but the acreage is much smaller than that of peppermint. The 1936–47 acreage of peppermint and spearmint as reported by the United States Bureau of Agricultural Economics is shown in table 1.

[3] Farmers in the principal mint-growing sections are referred to the following publications for further information:

Indiana, La Fayette—ELLIS, N. K. MINT CULTURE IN NORTHERN INDIANA. Ind. (Purdue) Agr. Expt. Sta. Cir. 227, 12 pp., illus. 1937; GOULD, G. E. INSECT PESTS OF MINT. Ind. (Purdue) Agr. Expt. Sta. Cir. 211, 8 pp. 1935.

Oregon, Corvallis—BOUQUET, A. G. B. PEPPERMINT PRODUCTION FOR OIL. Oreg. Agr. Col. Ext. Cir. 221, 5 pp. 1925. [Processed.]; THOMPSON, B. G. INSECT PESTS OF MINT IN OREGON. Oreg. Agr. Expt. Sta. Cir. 384, 5 pp., illus. 1946. [Processed.]

Michigan, East Lansing—DUNCAN, J. R. PEPPERMINT GROWING IN MICHIGAN. Mich. Agr. Expt. Sta. Spec. Bul. 153, 11 pp., illus. 1926.

Washington, Pullman—JOHNSON, O., and SNYDER, J. C. PEPPERMINT OIL PRODUCTION IN WASHINGTON. Wash. State Col. Ext. Serv. Bul. 227, 8 pp. 1936.

TABLE 1.—*Acreage and production of mint oils in the United States for 1946 and 1947 and the average acreage and production for the period 1936–45*

PEPPERMINT AND SPEARMINT COMBINED

State	Acreage			Production of oil			Yield of oil per acre		
	Average, 1936–45	1946	1947	Average, 1936–45	1946	1947	Average, 1936–45	1946	1947
	Acres	*Acres*	*Acres*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*Pounds*	*Pounds*	*Pounds*
Indiana	16, 340	25, 500	28, 300	438	675	897	25. 9	26. 5	31. 7
Michigan	19, 410	16, 500	18, 000	527	348	428	26. 7	21. 1	23. 8
Ohio	280			8			30. 8		
California	770	600		30	16		40. 4	27. 0	
Oregon	3, 620	9, 000	11, 000	152	396	550	41. 5	44. 0	50. 0
Washington	2, 060	4, 200	4, 400	91	206	209	43. 8	49. 0	47. 5
Total, 6 States		55, 800	61, 700		1, 641	2, 084			
Average	42, 480			1, 246			29. 2	29. 4	33. 8

PEPPERMINT

Indiana	12, 520	18, 000	18, 500	319	450	574	25. 1	25. 0	31. 0
Michigan	17, 390	14, 000	13, 500	462	266	270	26. 0	19. 0	20. 0
Ohio	280	[1]	[1]	8			30. 8		
California	610	600	[1]	23	16		41. 0	27. 0	
Oregon	3, 620	9, 000	11, 000	152	396	550	41. 5	44. 0	50. 0
Washington	2, 060	4, 200	4, 400	91	206	209	43. 8	49. 0	47. 5
Total, 6 States		45, 800	47, 400		1, 334	1, 603			
Average	36, 480			1, 056			23. 9	29. 1	33. 8

[1] Not available for publication; less than 3 growers.

TABLE 1.—*Acreage and production of mint oils in the United States for 1946 and 1947 and the average acreage and production for the period 1936–45*—Continued

SPEARMINT [2]

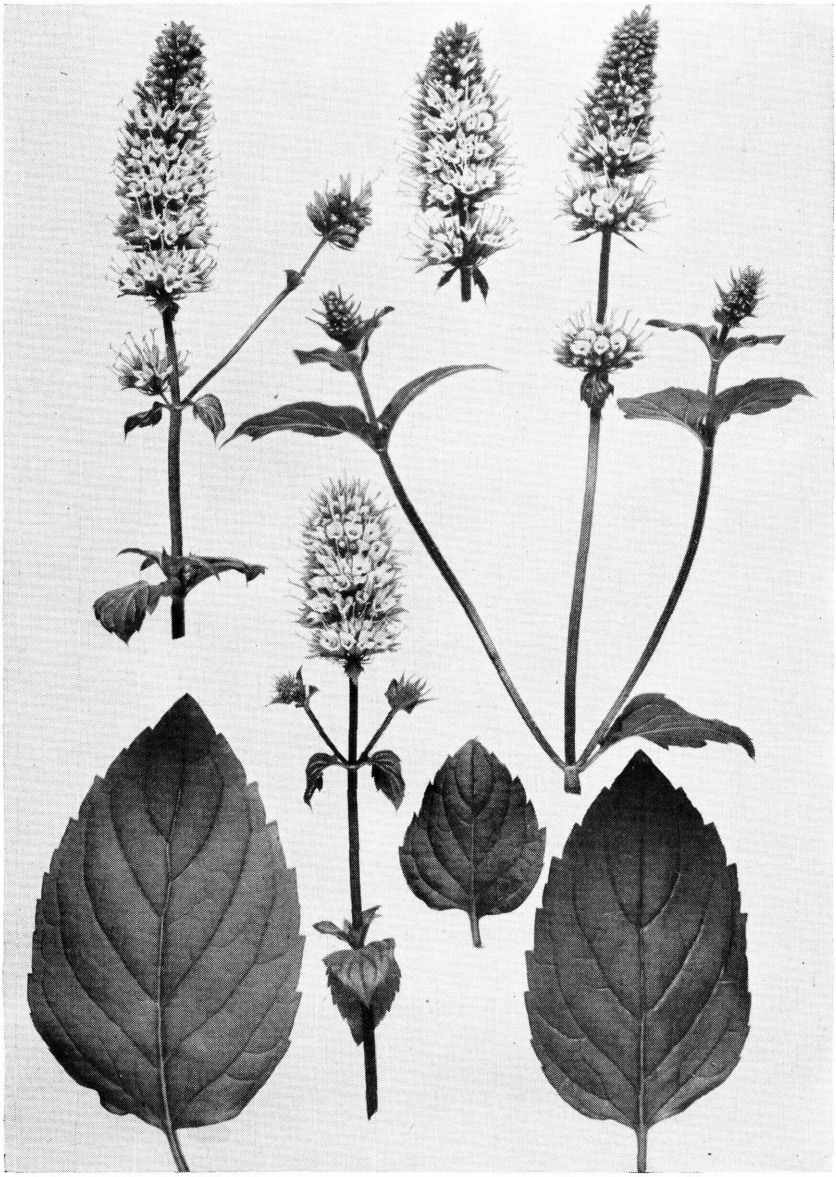
State	Acreage			Production of oil			Yield of oil per acre		
	Average, 1936–45	1946	1947	Average, 1936–45	1946	1947	Average, 1936–45	1946	1947
	Acres	*Acres*	*Acres*	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*	*Pounds*	*Pounds*	*Pounds*
Indiana	3, 820	7, 500	9, 800	118	225	323	27. 8	30. 0	33. 0
Michigan	2, 020	2, 500	4, 500	64	82	158	32. 0	33. 0	35. 0
Total, 2 States		10, 000	14, 300		307	481			
Average	5, 840			182			30. 1	30. 7	33. 6

[2] No spearmint has been grown commercially in the United States in recent years outside of Indiana and Michigan.

TYPES AND DESCRIPTION OF MINTS

Peppermint (*Mentha piperita*) (fig. 2) occurs as three commercially important horticultural varieties, usually referred to as black, white, and American. All three yield the peppermint oil of commerce, but they differ somewhat in appearance, growth habit, and adaptability to the cultural conditions found in this country

FIGURE 2.—Peppermint, showing characteristic leaves and flowers.



Black peppermint (also commonly known as black mint, English peppermint, and Mitcham mint [4]) is the variety most extensively grown, since it gives the best yields and is relatively more hardy than the others. It has dark-purple stems and deep-green, broadly lanced, slightly toothed leaves. The flowers are light purple and are produced in terminal spikes.

White peppermint (known also as white mint, Mitcham mint, and white Mitcham) is not cultivated commercially in the United States at present, but is still grown to some extent in England. It is less hardy and productive than the black peppermint, but it has been claimed that it yields a finer oil. It is smaller than the black peppermint and has green stems and light-green, slightly pointed, deeply toothed leaves.

American peppermint (known also as American mint and State mint) was probably the first variety grown in the United States. It is similar to black peppermint, but has green stems and lighter green leaves. Although this variety is very hardy, it yields less oil than the black mint and therefore is of little commercial value and should be excluded from cultivation.

Spearmint (*Mentha spicata*) and a horticultural variety known as Scotch spearmint are shown in figure 3. Both have some of the characteristics of peppermint but can be distinguished readily from it. Common spearmint has longer, lighter green leaves and more slender flower spikes. Scotch mint is more pubescent (hairy) and has its flowers in whorls in the leaf axils. It has largely replaced the common type in commercial plantings because it has greater vigor and productiveness.

Japanese mint (*Mentha arvensis* var. *piperascens*) is often erroneously called Japanese peppermint. Other countries grow this plant for its high menthol content, but it should not be confused with true peppermint, as the oils of the two are very different.[5]

A number of forms of native mint occurring naturally in many parts of the United States contain oil, but it is of poor quality. These plants have no commercial value, and if mint culture is to be undertaken on land where they occur they must first be thoroughly eradicated before the commercial variety is planted; if allowed to remain to any considerable extent they will affect unfavorably the quality of the oil obtained.

The mints are perennial plants with square stems. They produce profuse blooms, but the commercial varieties rarely set seed. They reproduce readily, however, by means of stolons, which are specialized stems that grow under and on the surface of the soil and provide a means by which the plants spread. Growers commonly call them the root, rootstock, or runner. They spread in all directions near the surface of the ground, sending up new growth at the nodes or joints. The plants grow to a height of 3 feet, and even higher if the soil is rich and they are crowded. When grown in rows or kept sufficiently thinned out, the plants develop numerous side branches and assume a bushy character.

[4] The term "Mitcham" has been applied rather loosely at times by growers and writers to several different types of mint, since the early introductions of peppermint came from a district in England known as Mitcham.

[5] Japanese mint is grown to a limited extent in the United States. Information regarding its culture may be obtained from the Division of Tobacco, Medicinal, and Special Crops, Plant Industry Station, Beltsville, Md. The Federal Food and Drugs Act requires that products in which Japanese mint oil is used be labeled "flavored with corn mint" or "flavored with field mint."

FIGURE 3.—Spearmint, showing typical flowers and leaves: Left, Scotch, and right, common.

The oil occurs in minute glands, mostly on the undersurface of the leaves, so it is obvious that the yield depends largely on the proportion of leaf surface present. It is important, therefore, that the cultural practices employed be such that the plants will develop as much of the bushy character as possible.

CULTURAL DIRECTIONS

SOIL REQUIREMENTS

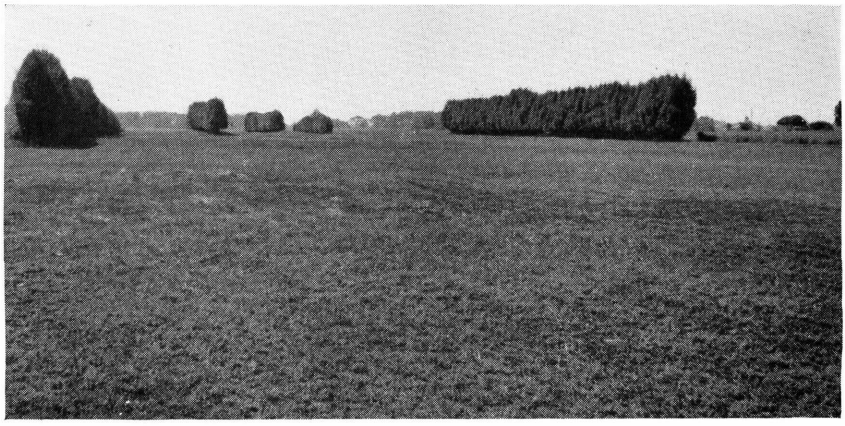
Mints can be grown on a wide range of soil types, but do best on deep, rich soil that has fairly loose texture and permits easy root penetration. Land that contains a large proportion of clay is usually unsatisfactory. The soil should be well drained but of a type that does not become too dry. On drained muck lands, where it is possible to control the water level by the use of gates in the drainage ditches, the water table should be held at about 2 feet from the surface until just prior to cutting time, when it is advisable to lower it to 30 or 36 inches.

An abundance of humus is desirable, and the soil should not be too acid or excessively alkaline (the preferred pH range is between 6.0 and 7.5). A very acid soil may require the application of limestone before it is used for mint production. Suitable growing conditions are most readily available in the well-drained muck soils used for celery, onions, cabbage, and similar crops that require the quickly available soil elements necessary to produce strong and rapid growth. Deep, fertile upland soils of sandy or gravelly loam texture that will produce potatoes and corn are also reasonably suitable for mint culture.

The large level tracts of muck lands common in Michigan and Indiana are subject to severe blowing in spring after prolonged drought, when strong winds lasting several days are not unusual. When driven by the wind, the fine particles of sand present in the muck gradually cut the tender young growth to pieces and thus cause extensive damage. In areas where the landscape is broken by occasional stands of timber the damage from blowing is much less.

The use of windbreaks reduces damage from blowing. Permanent plantings of willow trees in a mint field to serve as windbreaks are shown in figure 4. These are usually planted in rows running north and south, but occasionally a few rows are planted in the opposite direction, thereby further reducing blowing. If tree windbreaks are not used, blowing can be reduced somewhat in first-year mint by planting strips of rye at intervals throughout the field.

FIGURE 4.—Willow windbreaks in a harvested mint field in northern Indiana.



In the Pacific coast district sandy loam soils are next in importance to muck land for growing mint. They are found at a higher elevation along the Willamette River. Like the muck soils, they are drained by ditches or dikes and in most cases are subject to overflow in spring. With good cultural practices they are well adapted to mint production.

Mint farming under irrigation has been introduced in the Yakima Valley in Washington on lands previously used for alfalfa and fruit. Extensive areas have been planted in the several irrigation districts extending from Yakima in the south-central part of the State as far east as the Kennewick district. The soil in this region is mainly sandy loam, but some plantings have been made on clay loam.

PREPARATION OF THE SOIL

If the land selected for mint culture has not been under cultivation previously it should be plowed in summer or early in fall and then left fallow and kept free of weeds until the time for planting. If mint is to be planted on land already under cultivation it should follow a crop that in the preceding season was clean-cultivated. The eradication of perennial grasses is especially desirable. These grasses are difficult to destroy or control after the mint has spread beyond the planted rows because the ground can no longer be worked frequently with deep cultivators.

In the Middle West the muck land to be used for mint may be plowed either in fall or in spring. Some growers prefer fall plowing because they have more time then and can prepare the ground for planting somewhat earlier in spring. It may be necessary, however, to disk it in both directions at planting time, in order to get it in the best condition. If fall plowing is not practicable the plowing should be done early in spring or as soon as the land is dry enough to permit field work. After plowing, the field is disked and thoroughly harrowed and, if the soil is loose and dry, it is frequently rolled in order to firm it. In the Pacific coast district lands that are subject to brief periods of flooding during winter and early spring are not generally fall-plowed, because of the greater danger of the soil washing. The land should be worked as long as possible before planting, as this reduces the weeds, which cause a great deal of trouble in a mint field.

FERTILIZERS

No general recommendations can be made for fertilizers for mints, since type of soil, preceding cropping, and management of the planting will determine the kind and rate of application. It is usually profitable to apply a small quantity of fertilizer to new land, in order to insure a good stand from spreading plants, especially for the second year.

Workers at the Purdue Agricultural Experiment Station recommend the following method of fertilizing mint in northern Indiana: Apply 300 to 500 pounds per acre of 0–10–20[6] or 0–20–20 fertilizer, depending on whether the preceding crop was heavily fertilized with potash. On cold, wet soil apply 100 pounds of a high nitrogen fertilizer. Older plantings of mint should have a top dressing of 250 to 500 pounds of 2–8–16 fertilizer broadcast and harrowed or drilled in. Apply fertilizers containing nitrogen only in spring or immediately after the mint is cut, as little if any benefit will result from nitrogen applied in

[6] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

fall. Fall applications of 0–8–24 may be made before plowing the mint under for winter, in which case it is advisable to top-dress early in spring with about 100 pounds of a fertilizer that contains readily available nitrogen, as nitrate of soda.

Manure may be used instead of commercial fertilizers. It is recommended more often for upland soils, however, as applications on muck soils are reported to lower the yields of oil in dry weather. If manure is used, it is necessary to apply several tons per acre in order to get the same results as with commercial fertilizers. The manure used should be well rotted, otherwise it will contain many viable weed seeds that will materially increase the weed problem.

IRRIGATION

The mints require considerable water throughout the growing season. This makes it necessary to resort to irrigation in one form or another in some of the regions in which the crop is grown. The crop requires 50 to 60 inches of water in south-central Washington and eastern Oregon, where there is little summer rainfall. Beginning early in May, therefore, furrow irrigation is used at intervals of 1 or 2 weeks, depending on the prevailing conditions. The first year mint is irrigated by means of a single furrow made between the rows. In meadow mint shallow ditches or rills are made about 30 inches apart with implements designed for the purpose. The furrows are often made where the row was planted in the previous year.

In some localities in western Washington and in the Willamette Valley in Oregon the usual practice is to irrigate the crop with sprinklers one to five times during the season, according to need. On muck soils that have been ditch-drained, subsoil irrigation by raising the water level with ditch gates is a practical way of providing water to the root system as needed.

PROPAGATION AND PLANTING

Propagation by stolons is the method most widely employed, but the use of young plants, especially under certain conditions, is now extensive. Stolons for planting are obtained from a field previously selected for the purpose, usually one that was planted during the preceding spring. To assure the best quality of planting stock, only a field that had produced a thrifty, vigorous stand should be set aside for this purpose.

The removal of stolons from the ground is accomplished in several ways. They may be plowed out or dug with a potato digger and then shaken out of the loose soil with pitchforks and deposited in convenient piles. These piles must not be too large or the stolons will heat and spoil. The vitality of stolons is easily reduced if they are permitted to wilt through exposure to sun or wind. The approved practice is to cover the piles with dirt or other material if the stolons are not to be planted immediately.

In the Pacific coast district stolons are frequently dug from older fields in muck soil where the plants have spread and where the soil is crowded with stolons. The field is cut with some convenient implement into blocks about 18 inches square, which are then lifted with a pitchfork and the soil shaken out. A large yield of planting stock in such cases is reported.

As a rule, mint becomes established with little difficulty if the stolons are in good condition when planted and the growing conditions are favorable. Planting in very dry soil is inadvisable, especially if there is no prospect of an early rain. In order to retain as much moisture as possible, the furrows should not be laid off faster than the planting proceeds, so that the stolons may be laid in the slightly damp soil and covered immediately.

Planting is begun as early as conditions warrant. In the West, growers usually begin early in March, but in Indiana and Michigan the muck lands are not generally in workable condition until a month or more later. The ground should be reasonably warm and not too wet. Prolonged cold and wet weather immediately after planting frequently causes the planting stock to rot. Late spring frosts do much damage when they follow a period of warm growing weather that has caused the young growth to appear above ground. While the destruction of this new growth by frost does not kill the stolons, it depletes their strength and frequently prevents a full crop from developing.

Immediately before planting, the field is laid off with some suitable implement in furrows 4 to 6 inches deep and about 3 feet apart, or spaced to suit cultivating equipment. Usually a home-made drag with proper furrowing tools is satisfactory. Planting is done either by hand or by machines. When planting by hand, the worker takes the stolons out of a sack carried by a shoulder strap and drops them lengthwise and end to end into the furrow. As he moves along he pushes the dirt over them with his foot and packs it down by walking on the row. If the pieces are not satisfactorily covered by this method the covering may be completed by means of a leveler or shovel plow.

An experienced worker can plant as much as an acre a day, but inexperienced help will not average more than half an acre. These estimates are based on the practice of laying the pieces end to end in rows 3½ feet apart. Much depends also on the condition of the soil. Deep loose soil makes walking laborious and slows up the planter. The condition of the planting stock is also a factor.

At present machine planting is in general use, especially on the large mint farms. A number of the machines designed make it possible to plant several rows at a time—in one operation opening the furrow and dropping and covering the stolons.

The quantity of planting stock required per acre depends on the spacing in the furrows and the distance between the rows. An acre of well-established mint in which there has been no winter damage will frequently yield enough stock to plant 20 acres, but on the average only enough for 10 or 15 acres. If a grower is selling stolons to another grower in the same locality the usual practice is to sell a designated area in the field and let the buyer do the digging and hauling himself. On the average about 20 sacks of stolons are required to plant an acre. New growers usually purchase only sufficient planting stock for a few acres and in subsequent years enlarge their plantings from their own stock at comparatively small cost.

If stock is sold to distant points it is usually packed in grain sacks and shipped with as little delay as possible. Even under the best conditions too much moisture and lack of ventilation generally cause some loss in such planting stock, either from drying or from decay. The cost of planting stock depends largely on the demand. When oil prices are high the demand for stock is usually brisk, and this naturally increases its price.

New fields are sometimes started by means of young plants. In a well-established mint field innumerable young plants that come from the joints or nodes of the stolons will appear in spring. When these are about 4 or 5 inches high they can be pulled readily out of the ground, especially out of muck soil, and will have a small cluster of roots at the base of the stem. Such young plants can be transplanted under reasonably favorable conditions after permanent warm weather has arrived. Machines such as are used for transplanting tomato, cabbage, and similar plants have been found useful for setting young mint plants in the field. In addition to the men who operate the planting machine, at least two men are required to pull the plants and possibly an additional man to bring them to the planter.

The use of young plants instead of stolons for starting the mint field has certain advantages. The planting can be undertaken late enough in spring to avoid the cold weather that so frequently retards or even destroys young growth from stolons. The lateness of the season may prevent successful replanting with stolons, but young plants can be used to advantage. It is thus possible to obtain full production from an acreage that would otherwise be unproductive or be abandoned because of a poor stand or a poor condition of plants.

CULTIVATION

The mints require frequent cultivation to prevent the growth of weeds (fig. 5). Frequent use of fine-toothed harrows and weeders or rotary hoes (figs. 6 and 7) is recommended on both old and new fields.

FIGURE 5.—Mint field, the foreground weed free, the middle background very weedy; such weeds would ruin the quality of the mint oil distilled.

These implements do little damage to mint plants up to 5 or 6 inches in height. They are an efficient means of weed control if used frequently for working the soil when the weeds are small. New fields are cultivated between the rows with ordinary cultivators until the spread of stolons into the open spaces makes further tillage inadvisable. Further weeding must be done by hand.

Second-year fields are worked with spring-toothed cultivators or harrows as early in spring as possible. This loosens the soil and at the same time destroys many of the weeds. If stolons are abundant and the new growth is dense this practice may be continued for some time.

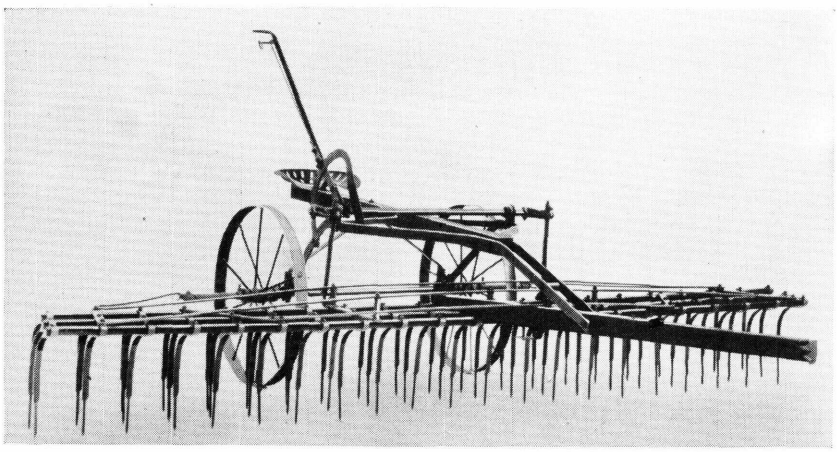


FIGURE 6.—Weeder of the type commonly used on mint plantings.

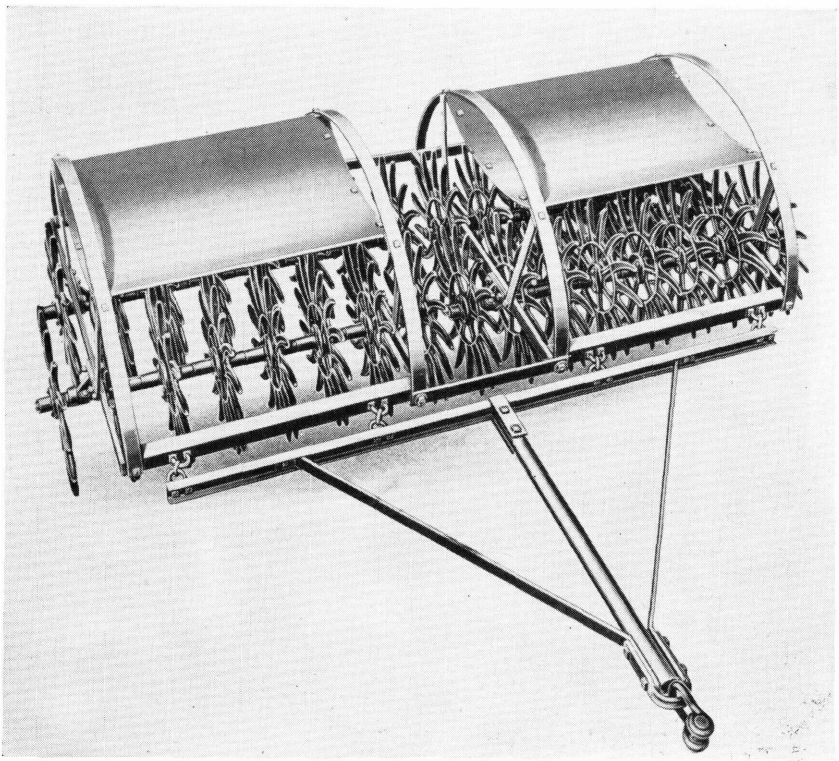


FIGURE 7.—Rotary hoe of the type used for cultivating mint.

The thinning that results from the use of such implements is beneficial to the crop, which otherwise has a tendency to become too thick. Cultivation cannot be continued long enough to control the weeds completely unless the field has been kept clean in the preceding year. Hand weeding is therefore usually necessary, and weeding crews are

sent through the fields several times during the summer to remove the weeds that are most likely to reduce the quality of the oil.

Nettles, marestail, pigweed, ragweed, and smartweed are common and objectionable. Some weeds color the mint oil, others contain oil with pronounced odors and are particularly to be avoided. Various grasses frequently cause considerable trouble under the conditions usually found in older mint fields. Although these may not affect the oil unfavorably to the same extent as the weeds mentioned, they are difficult to eradicate, since most of them are perennials and spread rapidly by means of rootstocks.

To keep down the weeds and grass in second-year or older plantings, sheep are sometimes used in western Oregon, beginning about June 1. They will not bother the mint unless other plants are scarce or the mint is small. Lambs and yearlings are preferred for weeding because sheep that are kept on the fields for several years become accustomed to the mint and may eat a considerable quantity. The usual rate is one sheep per acre.

After the mint crop has been harvested, the fields receive no further attention until late in fall, unless some fertilizer is added. Fields in the central districts are plowed before the first heavy frost is likely to occur. Earlier plowing may be followed by warm weather and is therefore not advisable, since the stolons should remain entirely dormant after they have been turned under. Fall plowing is especially desirable because the stolons are comparatively close to the surface and are subject to much winter damage if not turned under 4 or 5 inches. The furrow slice should be turned over flat to a depth of about 6 inches. Deeper plowing will result in a decreased stand the following year.

FIGURE 8.—A Michigan mint field in June. Left, second-year, or meadow, mint; right, first-year, or row, mint.

In the case of spearmint the fields frequently are not plowed until spring, since the stolons of this mint are deeper in the ground. In the Pacific coast district fall plowing is recommended only on land that does not wash during heavy winter rains or spring overflows.

Mint is grown as a row crop the first year and then allowed to spread over the field in subsequent years, producing a solid stand often spoken of as "meadow mint" (fig. 8).

If it is desired to keep the same planting of mint for several years, the cultural requirements are the same in succeeding years as in the second. It has been found more profitable in most cases to keep a field in mint for only 2 years, because the yield decreases and the cost of weeding increases as the stand gets older. The shorter rotation also gives better control of diseases. Planting corn in hills seems to be preferred immediately following mint because it is easier to eradicate volunteer mint from a field that can be cross-cultivated. It is difficult to eradicate mint fron such row crops as carrots and onions, in which it can become a pest.

DISEASES AND PESTS

The mints are subject to attack by three serious diseases, all caused by microscopic fungi—anthracnose, verticillium wilt, and mint rust—and by insect pests, particularly the mint flea beetle.

ANTHRACNOSE

Anthracnose (fig. 9), originally called leopard spot,[7] has been very destructive at times, especially in Indiana. The first symptoms are small brown sunken spots on young stems and stolons. These areas enlarge and become oval, with a light, ash-colored center surrounded by a dark-reddish border. Often the spots come together, forming large cankers that may cause the stem to crack. Heavy infections may kill young stolons and stems.

The leaves also are attacked. On young leaves small brown spots can be seen from both sides. In later stages these spots become round and light brown with a dark margin. Sometimes the centers fall out, giving a shot-hole appearance. The infected plants are weakened and young tender tissue is often killed, resulting in lower yields of oil. Anthracnose may be especially severe on the new shoots that come out after the mint is cut, and plants thus weakened may fail to overwinter.

The organism causing the disease overwinters mainly on old mint refuse and not in the soil proper. Some control is reported by the frequent application of a 20–80 copper lime dust or by spraying about six times during the season with a 3–3–50 bordeaux spray. The most practical and economical means of control, however, seems to be in carefully plowing under the old mint in fall. It is advisable to equip the plow with trash shields, so that all of the old mint is covered. Stolons that are buried thoroughly rarely produce plants that are infected, even if the stolons came from infected plants of the year before. When new fields are planted, disease-free planting stock should be used if obtainable, since the disease is introduced into new localities on infected planting stock. Anthracnose is apparently not an important disease in mint fields in Michigan.

[7] Caused by the fungus *Sphaceloma menthae.*

FIGURE 9.—Anthracnose (leopard spot) of mint, showing typical spotting of stems and leaves.

VERTICILLIUM WILT

Verticillium wilt [8] is a serious disease in Michigan and Indiana and has been reported in Oregon. Many acres of good mint land in Michigan are not planted to this crop, because of the presence of wilt. The disease first appears in May and June. Affected plants are dwarfed

[8] Caused by a fungus of the genus *Verticillium*.

and may show uneven growth, and the top leaves are bronze-colored. Later in the season the plants become progressively yellow, usually from the lower leaves up, as the organism moves upward in the plant. During dry weather affected plants die rapidly.

Control of wilt is difficult because the verticillium organism remains in the soil for long periods. Crop rotation has thus far been of little value in control, since growers have reported instances where mint was not planted on wilt-infested soil for many years but as soon as those fields were used for mint again the planting became infected. The seriousness of the disease can be reduced somewhat on muck lands by maintaining the water level at 18 to 20 inches where this is possible with the aid of gates in the drainage ditches. In the case of spearmint the disease usually develops late enough in the season for most of the crop to be saved by cutting as soon as wilt begins to appear.

The most promising method of control appears to be in the development of types of mint resistant to verticillium wilt. All varieties of peppermint and spearmint grown commercially are reported to be susceptible, but two other mints are known to be resistant, and these may be useful for the development of disease-resistant types that will produce a satisfactory oil. At present no resistant types are available for commercial production.

MINT RUST

Mint rust [9] is not so important in the United States as anthracnose or wilt but may cause considerable trouble at times, especially on spearmint. In spring and early in summer the disease appears in the form of light-yellow to brown raised spots on deformed stems and leafstalks and sometimes on the main leaf veins. In summer and fall golden or cinnamon-brown to dark chocolate-brown spots are found on stems and leaves. Rust may reduce the oil yield, since badly diseased leaves curl and die and the quantity of oil in other infected leaves is reduced. When rust begins to be serious it can be controlled by dusting with sulfur or spraying with bordeaux mixture. Early cutting is recommended on fields that have become badly infested.

INSECT ENEMIES

The mint flea beetle is the most important insect pest of mint. The beetles feed on the top growth, where they eat small holes in the leaves and may feed on the stems. During the hottest part of the day the beetles collect on the under sides of the leaves and stems or in the shade on the ground. Beetles alighting on the soil in the direct sun may be killed by the extreme heat. Plants heavily attacked lose many of their leaves and become brown. The larvae of the beetle cause more serious damage than the adults, as they feed on the underground parts of the plant and destroy the stolons and root system. They attack the small roots first, and can be found tunneling through these and later through the larger roots. Sometimes they girdle the roots, while at other times they tunnel up the root and into the stem. Affected plants are stunted, take on the reddish appearance of frosted plants, and may die.

Beetles can be controlled to some extent by crop rotation or summer fallowing. Under either of these practices the fields and surrounding ground should be kept clean of any volunteer or wild mint, as beetles

[9] Caused by *Puccinia menthae.*

will survive on these. Most of the life cycle of the flea beetle is in the soil, so any control measures using dusts must be applied in the short time during which the majority of the adult beetles are above ground and before the females have begun to lay their eggs in the soil.

In Indiana and Michigan the adult beetles usually appear some time during July. After feeding for about 3 weeks they mate, and shortly thereafter the females begin depositing eggs on or in the soil. Eggs are laid until the beginning of cold weather. Dusts should be applied during the period of approximately July 20 to August 5, depending on the locality. Since the adults feed for a period of 3 weeks or more before egg laying begins, the time for dusting may coincide with the harvesting operations. If this happens, it is advisable to cut the mint slightly earlier and then treat the stubble.

Apply calcium arsenate diluted with 5- to 10-percent bentonite, or dusting clay, at the rate of 15 pounds per acre for actively growing mint. On the stubble following the harvesting operation, dust paris green-flour mixture in the ratio of 1 to 9. Best results are obtained if the dusts are applied when the plants are covered with dew and when very little wind is blowing. Several applications may be necessary.

The spent hay must not be used for cattle feed if calcium arsenate (a poison) has been used on the crop.

Planting stock should be free of beetle eggs and larvae if possible. First-year mint should be protected against flea beetle invasion during July by applying poison to a narrow strip of the planting adjacent to any infested field. In Oregon, control of the mint flea beetle has been obtained by the use of 25 to 30 pounds of 90-percent cryolite dust or 5-percent DDT dust per acre, applied when beetles first appear on the leaves.

Mint is subject to attack by several minor insect pests, as cutworms, grasshoppers, white grubs, black vine weevils, strawberry root weevils, and millipedes. Growers are advised to request information from their State agricultural experiment station regarding these insects and methods for their control.

HARVESTING

It has been assumed generally that mint contains the maximum quantity of oil when the plants are in full bloom. Seasonal conditions, however, affect the blooming, and in some years meadow mint in particular blooms very little.

Investigators at the Purdue Agricultural Experiment Station have shown in recent years that the stage of blooming is not a reliable guide for determining the proper stage for harvesting. These workers have developed a test [10] by which the time to harvest can be determined rather accurately. The test is made by trial distillations of small representative samples from the field as the crop approaches its maximum growth.

Unusual weather conditions in some years advance or delay the mint harvest several weeks. In California most of the crop is ready in July; elsewhere the harvest period extends through August and

[10] ELLIS, N. K., SWIFT, L. J., and THORNTON, M. H. A METHOD FOR TELLING THE TIME OF CUTTING PEPPERMINT FOR HIGHEST OIL YIELD. Ind. Agr. Expt. Sta. Dept. of Hort. Mimeo. 3, 3 pp., illus. June 1944. [Processed.]

ELLIS, N. K., and GAYLORD, F. C. RELATION OF YIELD OF OIL FROM PEPPERMINT (MENTHA PIPERITA) AND THE FREE MENTHOL CONTENT OF THE OIL. Amer. Soc. Hort. Sci. 45: 451–454, illus. 1944.

sometimes well into September. In the Pacific coast district two harvests are frequently obtained, especially in California, because of the longer growing season. In Oregon and Washington it is generally necessary to cut the first crop earlier than usual if it is desired to get a second before heavy rains reduce the yield of oil and interfere with curing in the field.

On fertile muck soils when the stand is thick and rank a considerable loss of leaves occurs before the harvesting stage is reached. To avoid this and to develop a reasonably productive second crop, it is better to cut the crop early. The two-crop practice, however, is of doubtful value, even if the yield of oil is larger, unless the seasonal conditions make it possible to cut both crops at the proper time. The oil obtained from too early cutting is frequently of inferior quality and is lacking in the characteristics the market demands.

Formerly, row mint was sometimes harvested with scythes, but this practice has been generally discontinued. At present, both row and meadow mint are harvested with sickle-bar mowers, the sickle bar being fitted with one of several types of vine lifters. As row mint is cut one row at a time, the regular sickle bar must be shortened accordingly.

After the mint is cut it is allowed to lie in the swath a day or so until partially cured, when it is raked into windrows with a side-delivery rake. It is best to carry out this operation early in the morning while the mint is still tough. If the weather is fair and drying proceeds rapidly, the herb may be hauled from the windrows to the still. In dull weather it is frequently necessary to place it in small cocks like hay, to continue the curing. Some growers prefer this method as a regular practice. Others find it more economical to load directly from the windrow with hay loaders. Complete drying makes the herb brittle and should be avoided. In such condition it cannot be handled without loss of foliage and a resulting loss of oil.

The ordinary flat hay racks or specially constructed wagons with high sides are serviceable for hauling the herb (fig. 10). The material can be loaded onto these with the least labor and a minimum of shattering.

FIGURE 10.—Loading cured mint on hay wagons.

On some of the larger mint farms the herb is loaded and firmly packed directly into large metal forms hauled on low-bodied wagons or trucks. On arrival at the still the entire load is lifted out of the form by a crane or track hoist and chains attached to a sling that is laid on the bottom of the form before it is loaded. The crane or track hoist swings the load directly over a distilling tub,[11] into which it is then dropped. The forms are somewhat larger than the tubs and slightly wider at the top than at the bottom, which permits the load taken from it to fit snugly into the tub and to fill it completely.

By this method the time required for unloading and charging a tub is greatly reduced. It has the further advantage that loss of leaves due to handling with pitchforks or hay forks is avoided. The general practice is to transfer the herb from the wagon to the tub by means of pitchforks or to use some form of hay fork operated by a team of horses or by a crane and windlass. In some distilling plants steam or electric hoisting cranes are used.

DISTILLATION OF THE OIL

The process employed for removing the oil from mint consists of passing steam through the herb, thus vaporizing the oil. The steam and oil vapors are conducted through a worm or other form of condenser, where they are reduced to water and oil. The water and oil are collected in suitable receivers, in which they separate into layers, the oil floating on the surface. Although the equipment used for this purpose has been gradually improved, the method of operation has on the whole remained unchanged.

DESCRIPTION OF STILLS

A distilling unit [12] consists of a high-pressure boiler for generating steam, a tub, a condenser, and a receiver. The general arrangement of these several parts may vary according to conditions, but the whole equipment should be so assembled that the outfit can be installed at the lowest cost and operated with the greatest saving of labor. Generally even the smallest distilling units include two tubs operated with one condenser, so that one tub can be charged while the other is in operation or is being discharged. On the larger farms four or more tubs are usually operated in pairs, with a condenser for each pair. Sometimes a single large condenser is adequate for as many as four tubs.

Tubs

Since it takes less time to discharge and reload a tub than to complete the distillation, a more efficient arrangement in a multitub unit is to equip each tub with its own condenser. This makes it possible to keep the tubs in more nearly continuous operation and to eliminate some heavy iron pipes and valves that sometimes cause discoloration of the oil. Such a still is shown in figure 11.

The tubs are set down part way in a platform, which serves as a working floor, the tubs projecting usually about 2 feet above this floor.

[11] Several terms, as "tub," "vat," and "retort," are commonly used to designate that part of the distilling equipment in which the herb is packed.

[12] All stills, regardless of the purpose for which intended, must be registered with the U. S. Bureau of Internal Revenue. Applications for the required blank forms should be made to the U. S. Collector of Internal Revenue of the district in which the still is to be operated.

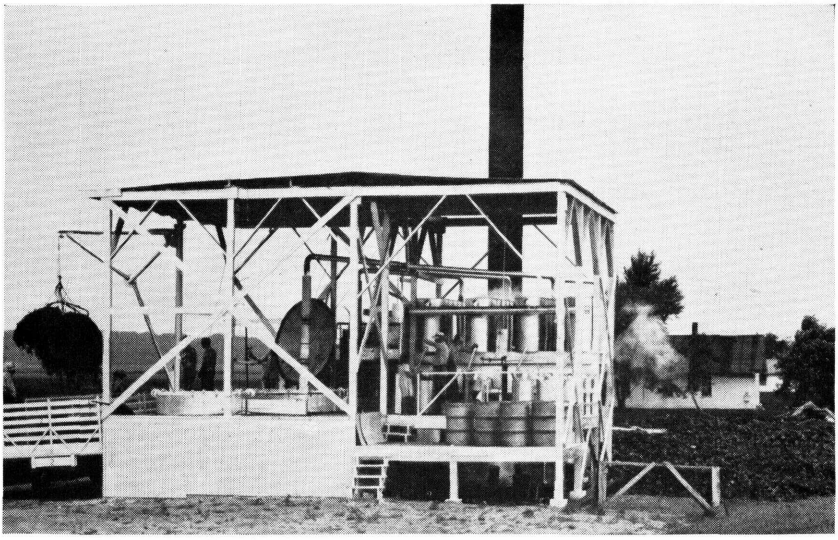


FIGURE 11.—Modern mint still, with a condenser for each tub. The herb is placed in a steaming tub (lower left), from which oil and water vapor pass to a condenser (upper right); the oil and water flow in liquid form to a receiver (oil separator), from which the water is drawn off as necessary and the oil is made to pass into a drum (lower right). For operation of oil receiver (separator) see figure 16.

A lifting windlass on a crane or track is mounted in such a position that it can be used for loading and discharging each tub.

The tubs in use vary somewhat in size. They are 6 to 9 feet deep and 6 to 7 feet in diameter, most of them measuring 7 feet in both directions. Some are made slightly larger at the top than at the bottom to facilitate the removal of the spent herb. In the early years of the industry they were constructed of wooden staves. At present cement tubs are used in some sections of the Pacific Northwest, but elsewhere most of them are made of No. 16-gage galvanized steel (fig. 12). The steam-tight gasket consists of a flat strip of composition material riveted to the rim of the tub or to the under edge of the cover, which is fastened down by means of adjustable eccentric clamps.

The steam is admitted from a 1½-inch pipe just above the bottom of the tub. An even distribution of steam through the charge is effected by means of a T with open ends. The outlet for the steam and oil vapors is through a pipe from the side just below the cover. This pipe has a diameter several times as large as that of the inlet pipe, in order to prevent pressure from building up in the tub. It usually extends upward and then passes overhead to the condenser (fig. 11).

The equipment sometimes used on the Pacific coast differs in some details from that described. It consists of metal tubs, each of which is fitted with an open collar around the rim about 5 inches wide and 10 inches deep. This collar is filled with water. The cover has a turned-down edge that fits into the collar, thus making a water seal. The vapors leave the tub through a gooseneck from the center of the cover and are conducted to the condenser. The union of the exit pipe and condenser is also sealed with water by a similar arrangement. When

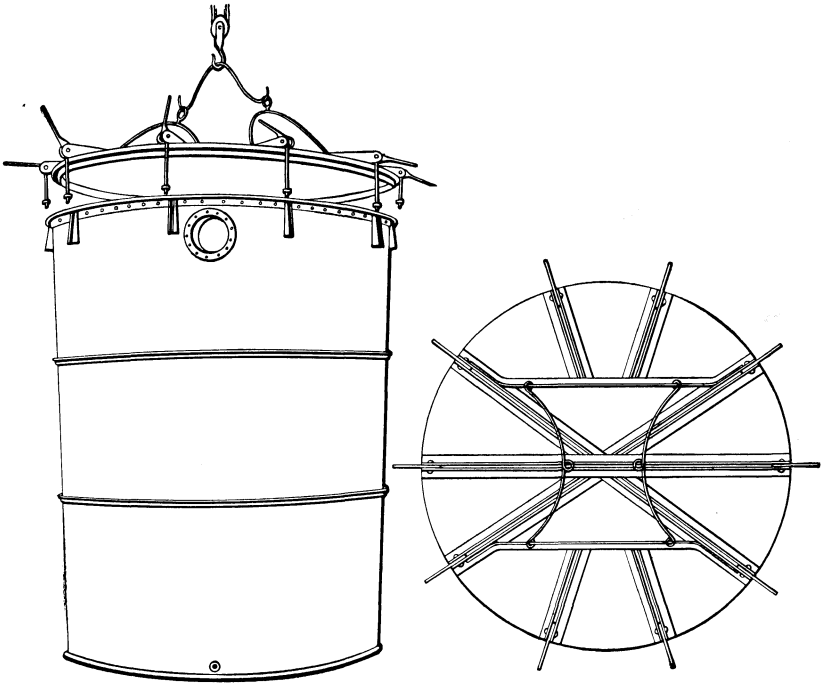


FIGURE 12.—Galvanized-steel mint tub of the type commonly used.

the charge in the tub is exhausted the cover is lifted by means of a hoist and swung over for use with the other tub. With this type of equipment no clamps are required, but steam pressure must not be allowed to develop in the tub or the cover will be forced up and the seal broken.

Condensers

The worm-type condenser has been in use for many years in one form or another. One type consists of six or eight horizontal sheet-metal pipes joined at the ends by elbows to form a continuous series (fig. 13). The first two lengths of pipe from the top are 7 or 8 inches in diameter, and the rest are reduced successively in size, the last one, from which the condensed oil and water flows, being 2 or 2½ inches in diameter.

Condensation is obtained by water flowing over the pipe from a perforated trough mounted directly above the condenser. This water drains into a lead-off trough at the bottom. On some condensers a lead-off trough is mounted below the third pipe with a second perforated trough immediately below it to furnish a fresh supply of cold water to the remaining pipes. The water flows to the troughs by gravity from a reservoir overhead. A steady and ample supply of water is drawn by pumps either from wells or from small streams in the vicinity of the stills. The hot water that drips from the condenser is frequently used in the boiler, with a considerable saving of fuel. At some convenient point in the upper part of the condenser is an air vent that can be opened when the steam is shut off. The air entering through it will prevent the condenser from collapsing, which other-

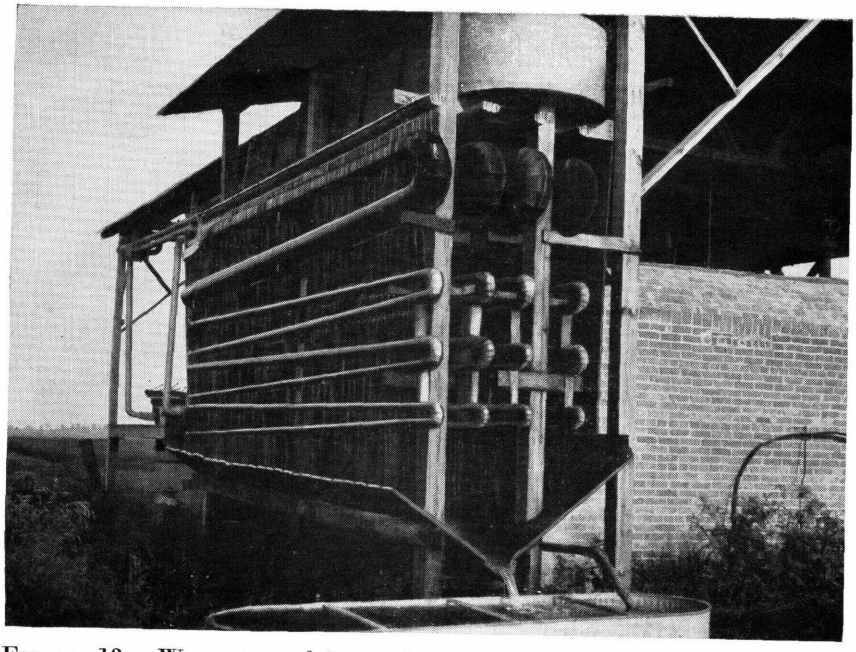


FIGURE 13.—Worm-type drip condenser used in the distillation of mint.

wise is likely to occur because air cannot enter fast enough through the small end of the condenser.

The type of condenser described came into extensive use mainly because it could be constructed at a small cost, but it is soon destroyed by rust. If built of copper pipe lined with tin, it will last many years.

The drip-type worm condenser has recently been replaced largely by a tank type (fig. 14), which consists of a worm arrangement similar to

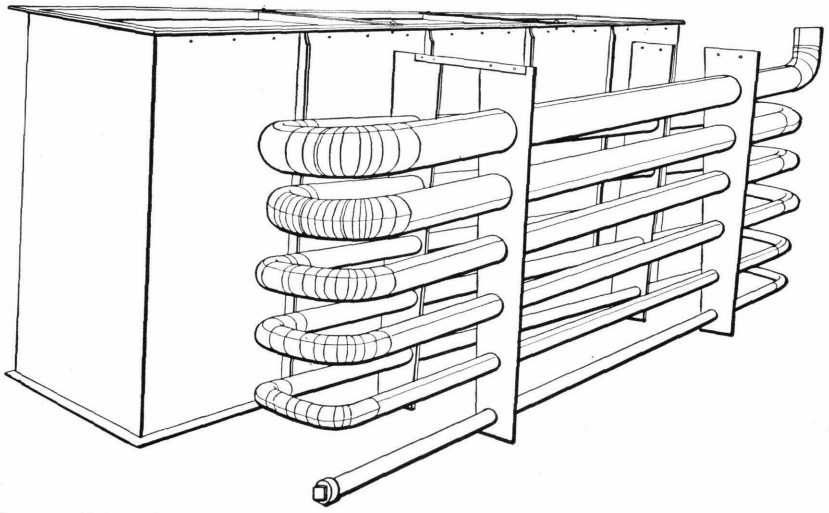
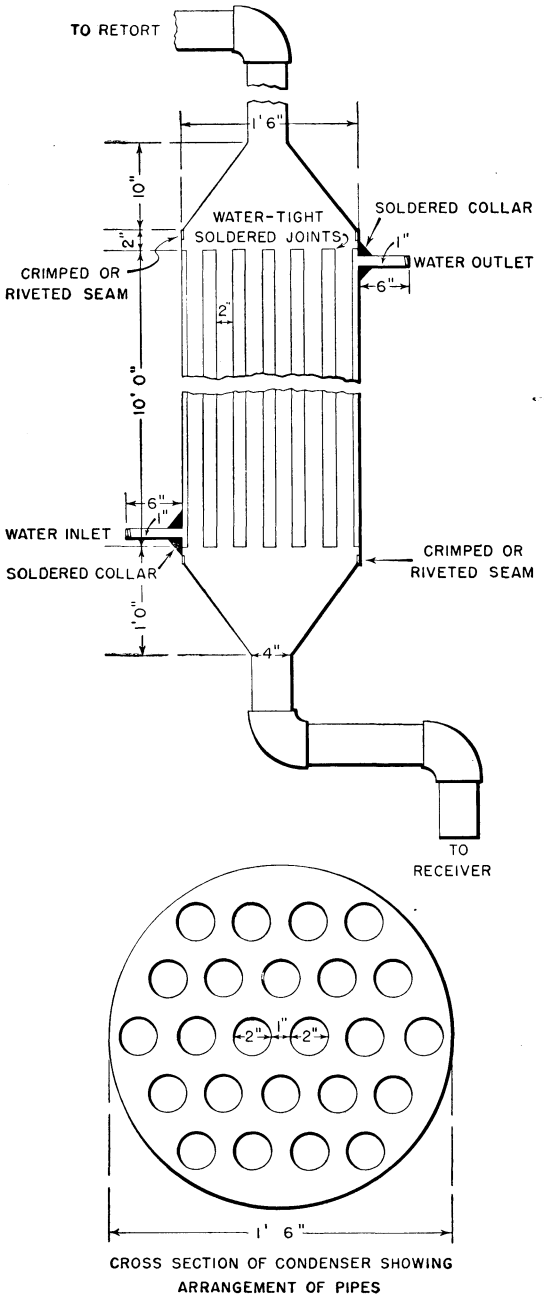


FIGURE 14.—Galvanized-steel tank-type worm condenser. When in operation the worm is inside the tank.



CROSS SECTION OF CONDENSER SHOWING
ARRANGEMENT OF PIPES

FIGURE 15.—Details of a tubular condenser.

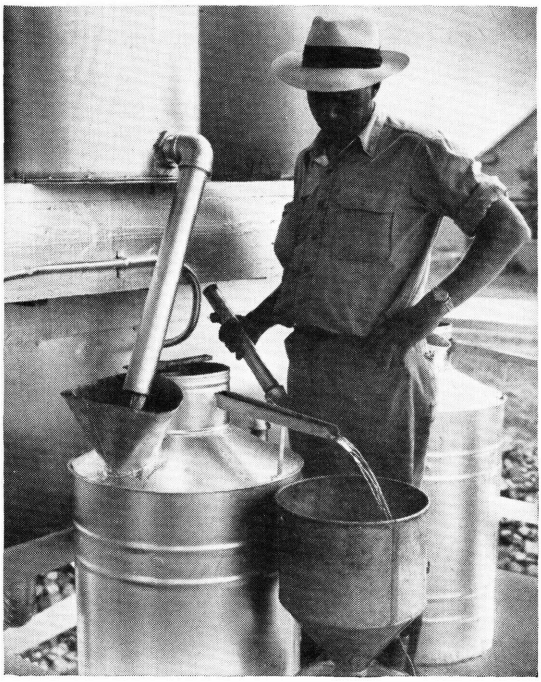
that used with the drip type, but the worm is enclosed in a large tank. Water enters the tank continuously, so that the pipes are bathed constantly in cool water.

A few growers are using tubular condensers. These consist of an upright galvanized-steel shell in which are mounted numerous upright galvanized-iron pipes of small diameter, somewhat like the flues in a boiler (fig. 15). As the vapors pass downward through the pipes they are condensed by the cold water that circulates around the pipes, and the condensed water and oil flow from a narrow outlet into the receiver. Though rather expensive, such a condenser lasts a long time, requires little space, and is very efficient.

Oil Receivers

The receivers in which the oil is collected are of simple design and construction. They are cylindrical and made of galvanized iron and vary in capacity from 10 to 50 gallons. Since the oil floats, the water is drawn off the bottom by means of a pipe that extends up along the side of the receiver to within a few inches of the top, where it is fitted with an elbow and a short extension pipe. As distillation proceeds, the surface of the oil in the receiver is maintained at the desired level by raising or lowering the end of the extension pipe from which the water drains. At a point near the top of the receiver is an outlet from which the oil can be drawn off (fig. 16).

FIGURE 16.—Removing peppermint oil from the receiver. The operator has brought the oil level up to the discharge spout by raising the extension pipe of the water outlet.



A number of devices are used to prevent churning of the contents of the receiver by the flow from the condenser, since this might cause some of the oil to be drawn off at the bottom with the water. One method is to direct the flow into a funnel-topped pipe that extends about half the distance to the bottom of the receiver, where it is fitted with a short return elbow that directs the oil toward the surface.

Another method is to admit the flow from the condenser into the receiver through a pipe at a point about two-thirds the way down, a baffle plate immediately below the inlet directing the separated drops of oil toward the surface.

Cost of Equipment

The cost of a mint still will vary considerably, depending on the location. At 1947 prices it is estimated that a two-tub still would cost $2,000 to $4,000. The boiler[13] is the most expensive unit, but a reconditioned one can sometimes be obtained at a considerable saving. If a larger unit is desired the cost can be figured at the rate of about $1,000 per additional tub. Part of this cost results from the fact that a multitub unit requires a correspondingly larger boiler. Naturally, a boiler should be purchased at the start that will be large enough for any anticipated expansion. The efficiency of a distilling plant depends largely on an ample supply of steam. The boiler, therefore, should be of sufficient capacity for all purposes. In most cases it is operated at a steam pressure of 85 to 100 pounds.

A farmer who is contemplating the production of mint oil in a locality where the crop is already being grown should investigate the possibility of having his mint distilled the first season or two by someone in the neighborhood who is already equipped to do the work. By doing so he will not have to make any investment for installing distilling equipment until he has found that he can grow the crop successfully under the prevailing conditions.

OPERATION OF STILLS

When a tub is charged, the herb is packed down thoroughly (fig. 17) so that the steam will pass uniformly through the charge instead of channeling, as is likely to occur in loosely or unevenly packed material. An iron ring or a crosspiece with chains attached is placed on the bottom, and when the tub is half full the chains are laid across the charge and the steam partly turned on. A second ring is then introduced and the loading completed. By means of these rings and chains and a crane the spent herb is easily removed from the tub in two batches. The slow admission of steam while loading is in progress makes it possible to pack the herb more firmly. After the cover has been clamped down, more steam is turned on, and when the condensed vapors of steam and oil begin to flow from the condenser the admission of steam is so adjusted that condensation is complete, with no loss of oil vapors.

The time required to exhaust a charge depends on the quantity of steam admitted and the condition of the herb. The drier the herb, the shorter the time required. Steam coming in contact with green herb is partly condensed, and a much longer time is therefore required to complete the operation. In most cases, if the herb has been well cured,

[13] In most States the laws require periodic inspection of steam boilers of the size and type used for distilling mint.

FIGURE 17.—Packing a tub with mint hay preparatory to distilling.

the steaming is continued for about 45 minutes or an hour. During this period the second tub is emptied and reloaded (fig. 18).

The exhausted material is deposited on wagons or trucks by means of a crane and hauled away. If spread out on the field and properly dried it makes excellent fodder and is commonly used for this purpose. It is relished by all kinds of livestock and in feeding value is reported to be equal to timothy hay. It is also used to advantage as a fertilizer, and when intended for this purpose is spread on the field and plowed under in fall. At times some growers deposit the refuse on large dumps, where it is allowed to decompose before being spread on the field.

As a rule the oil separates readily from the water in the receiver and if carefully removed is entirely clear. Some growers prefer to filter it before storing, but this is not usually necessary. The oil may be stored in 5- or 10-gallon tin cans or if large quantities are produced, in heavy 40- or 50-gallon galvanized drums or aluminum kegs. Rectification by a second distillation is not generally required unless the oil is highly colored, is of unusual composition, or is intended for use where only rectified oils are permitted. Generally, if the fields have been kept free from weeds and the distillation has been carefully conducted, the oil obtained is acceptable to the trade. Rectification usually cannot be undertaken to advantage by the average grower, although it is frequently done by large producers.

Both peppermint and spearmint oils may be kept for an indefinite period without material change in quality, if the moisture is removed and the oil is stored in a cool place in completely filled clean tin cans or drums with tight closures.

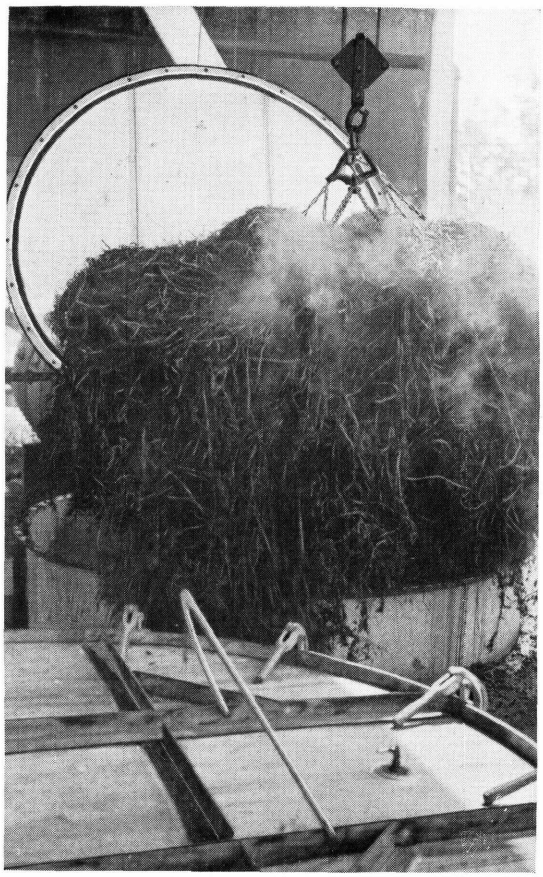


FIGURE 18.—Removing the spent hay from the tub after distillation has been completed.

YIELD OF OIL

The yield of oil from the mints varies greatly with seasonal and cultural conditions and geographic location. The average yields in the six principal mint-growing States during the 10-year period 1936–45, and for the years 1946 and 1947 are shown in table 1, page 3. Since the figures given are averages, it may be assumed that some farmers are getting better, others poorer, yields than indicated.

Spearmint yields more oil per acre on the average than peppermint, but the net income from this crop is generally somewhat less than that from peppermint, because peppermint oil usually brings a higher price.

The yield is reduced greatly if the plants are too thick in the field to permit full leaf development or if many of the lower leaves have fallen off on account of the continued dampness due to thick stands. Clear sunny weather during the few weeks immediately preceding the harvest causes the herb to develop more oil than it will in cloudy, wet weather. Heavy rains at harvesttime wash off considerable oil, and rough and excessive handling when the herb has been permitted to become too dry also causes loss through the shattering of leaves.

PRODUCTION COSTS

The cost of growing, harvesting, and distilling peppermint and spearmint fluctuates with price of planting stock, wage scales, and other local conditions. The costs vary greatly among farms, but labor is the greatest single factor.

In Indiana [14] the average cost per acre of producing peppermint oil ranged from about $37 to $51 in the 4-year period 1936–39, or $1.50 to $1.90 per pound of oil when average yields were obtained. Approximately 50 hours of man labor per acre were required. Labor costs represented 30 percent of the total cost in the first year of the crop and 25 percent in subsequent years. Weeding required 40 to 50 percent of all the labor needed. Greater net returns are generally realized from fields kept relatively free from weeds, insects, and diseases.

PRICE OF OIL

The prices paid to growers of mint oils have fluctuated considerably. Very high prices due to poor crops have led to an increased acreage, and this has in turn reduced prices at times below the cost of production. The extremely high price of peppermint oil in 1925 and 1926 was due to greatly reduced production, resulting from poor growing conditions in two successive seasons. Thereafter prices returned to more normal levels. From 1935 to 1941, inclusive, the price of peppermint oil ranged from $1.74 to $3.44 per pound, while that of spearmint oil ranged from $1.30 to $2.22. Under wartime conditions much higher prices prevailed, but they cannot be expected to continue indefinitely and should not be considered a basis for estimating the probable future returns from this crop.

PRODUCTION AND CONSUMPTION OF MINT OILS

The United States produces most of the world's supply of peppermint and spearmint oils. England, Germany, France, Italy, and Russia produce relatively small quantities. Japan and Brazil produce large quantities of oil of Japanese mint,[15] which is used as a source of menthol and is a very different oil from peppermint or spearmint.

Accurate statistics on the world's production of mint oils are not available. Some figures on production in the United States are given in table 1 (p. 3). The average annual production of peppermint oil during the period 1936–45 was 1,056,000 pounds. Statistics on the production of spearmint oil in the same period are available for Indiana and Michigan only, where the annual production averaged 182,000 pounds. Some spearmint oil was produced in California up to 1943, but commercial plantings were discontinued thereafter. The use of peppermint oil in the manufacture of several widely used products that are in increasing demand assures a steady market. Considerable quantities of American oil are exported to other countries in which the production is not sufficient to meet the requirements.

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[14] SMITH, M. G., and ROBERTSON, L. AN ECONOMIC ANALYSIS OF THE PRODUCTION OF PEPPERMINT AND SPEARMINT OILS IN INDIANA. Ind. Agr. Expt. Sta. Bul. 459, 31 pp., illus. 1941.

[15] See footnote 5, p. 6.

The adaptation of mints to local soils and climatic conditions and the cost of the labor required should be carefully considered before undertaking mint culture. The prospective grower should make a careful study of all the costs of erecting a still before growing this crop, particularly in a locality where there are no other mint growers with whom arrangements can be made for its distillation. The industry is especially subject to wide fluctuations in market conditions, and a period of attractive prices is apt to be followed by such increase in acreage as to cause overproduction.

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